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On the Babylonian Origin of Plato's Nuptial Number.—By GEORGE A. BARTON, Professor in Bryn Mawr College, Bryn Mawr, Pa.

THE attention of scholars was recalled to this subject by the publication in January, 1907 of Hilprecht's *Mathematical, Metrological, and Chronological Tablets*, which form vol. xx, Series A, of the *Babylonian Expedition of the University of Pennsylvania.* Hilprecht's reviewers gave him high praise for discovering the Babylonian origin of Plato's nuptial number. These reviewers included such scholars as Zimmern, Ungnâd, Hommel, Kittel, Zehnpfund, Sayce, Pinches, Johns, Teloni, Fossey, Ward, and Rogers. Among these the present writer was also found.[1] In all these reviews, however, the fact was overlooked[2] that in claiming the Babylonian origin of this Platonic number, Hilprecht had been twice anticipated, once by A. Aurès in 1893, and once by James Adam in 1902. Hilprecht used Adam's book without mentioning this fact !

As this subject is one which lies upon the borderland between Greek, Assyriology, philosophy and mathematics, it is not strange that Hilprecht's reviewers were not familiar with the history of the subject. No one unless he had made a special study of this borderland would be likely to know its history. Hilprecht's contribution to the subject was not a discovery of the Babylonian relationship, but he supplied some fresh Babylonian material, which confirmed the theory of Adam. The present paper is a sin-offering (אָשָׁם) by one of the reviewers for his sin of inadvertence (שׁגגה).

The passage in which Plato introduces this mystic number is said to be the most difficult passage in his writings. As it has suffered many interpretations at the hands of classical scholars, it may not be out of place to examine the passage and some of these interpretations, in order to be able to estimate more justly the value of the arguments for Babylonian influence.

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[1] See Philadelphia *Public Ledger* of February 18, 1907.

[2] Professor Johns, I am informed, discovered that Aurès had anticipated Hilprecht, but the editor of the *Classical Review* cut the reference to it out of his notice of the book.

The passage occurs in Book VIII of the *Republic*, p. 546 C D, and is as follows:—

> ἔστι δὲ θείῳ μὲν γεννητῷ περίοδος, ἣν ἀριθμὸς περιλαμβάνει τέλειος· ἀνθρωπείῳ δὲ ἐν ᾧ πρώτῳ αὐξήσεις δυνάμεναί τε καὶ δυναστευόμεναι, τρεῖς ἀποστάσεις, τέτταρας δὲ ὅρους λαβοῦσαι ὁμοιούντων τε καὶ ἀνομοιούντων καὶ αὐξόντων καὶ φθινόντων, πάντα προσήγορα καὶ ῥητὰ πρὸς ἄλληλα, ἀπέφηναν· ὧν ἐπίτροπος πυθμὴν πεμπάδι συζυγεὶς δύο ἁρμονίας παρέχεται τρὶς αὐξηθείς, τὴν μὲν ἴσην ἰσάκις, ἑκατὸν τοσαυτάκις, τὴν δὲ ἰσομήκη μὲν τῇ, προμήκη δέ, ἑκατὸν μὲν ἀριθμῶν ἀπὸ διαμέτρων ῥητῶν πεμπάδος, δεομένων ἑνὸς ἑκάστων, ἀρρήτων δὲ δυεῖν, ἑκατὸν δὲ κύβων τριάδος. ξύμπας δὲ οὗτος, ἀριθμὸς γεωμετρικός, τοιούτου κύριος, ἀμεινόνων τε καὶ χειρόνων γενέσεων, ἃς ὅταν αγνοήσαντες ὑμῖν οἱ φύλακες συνοικίζωσιν νύμφας νυμφίοις παρὰ καιρόν, οὐκ εὐφυεῖς οὐδ᾽ εὐτυχεῖς παῖδες ἔσονται.[1]

Recent interpreters of Plato seem to agree that *θείῳ γεννητῷ* refers to the world, the formation of which is controlled by a large number, and that Plato claims that human births are controlled by a smaller number which bears a certain relation to this larger number. Dupuis understands that the "perfect number" is 6,—a "perfect number" being, according to Euclid and the Greek mathematicians, a number which is equal to the sum of all its divisors. Thus $6=1+2+3$. Apparently, however, the meaning here is, not that six is the actual number, but that it lies at the basis of that number. Adam, therefore, understands this to be a reference to the number which expresses the gestation of the universe, and which Plato in this phrase leaves shrouded in silence and obscurity, but explains more fully in the last part of the passage.

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[1] This passage is translated by Jowett (*Dialogues of Plato*, III, 250 ff.) as follows (Jowett's mathematical parentheses and notes are omitted from this translation but will be given below):—"Now that which is of divine birth has a period which is contained in a perfect number, but the period of human birth is comprehended in a number in which increments by involution and evolution [or squared and cubed] obtaining three intervals and four terms of like and unlike, waxing and waning numbers, make all the terms commensurable and agreeing with one another. The base of these, with a third added, when combined with five and raised to the third power furnishes two harmonies, the first a square which is a hundred times as great, and the third a figure having one side equal to the former, but oblong, consisting of a hundred numbers squared upon rational diameters of a square [i. e. omitting fractions] the side of which is five, each of them being less by one than, or less than two perfect squares of irrational diameters; and a hundred cubes of three. Now this number represents a geometrical figure which has control over good and evil births. For when your guardians are ignorant of the law of births, and unite bride and bridegroom out of season, the children will not be goodly or fortunate."

There seems also to be general agreement that the number which controls human births, which is obtained by "squaring and cubing," by which "three intervals and four terms are produced," is 216 ($=6^3=3^3+4^3+5^3$). This is the view of Dupuis[1] (1881), Hultsch[2] (1882), Jowett[3] (1891), Campbell[4] (1894) and Adam[5] (1902). Some scholars have reached this conclusion by cubing 6, and some (as Adam) by adding the cubes of 3, 4 and 5.

With reference to Plato's meaning in the latter part of the passage quoted there is less agreement, though real progress seems to have been made in recent years in the elucidation of his meaning.

It was understood long ago (cf. Schleiermacher, *Platons Werke*, 1828, III, i, 590 ff.), that *πυθμήν* meant in Greek mathematical terminology the lowest number (or in the plural the lowest numbers) which express a given ratio. Thus in the ratios $\frac{1}{3}:\frac{1}{4}$, $3:4$, $6:8$, $9:12$, the *πυθμένες* are 3 and 4. *ὧν ἐπίτροπος πυθμήν* designates, it is agreed, the numbers 3 and 4 which formed two sides of the Pythagoræan triangle, but interpreters differ as to whether Plato intended to designate the numbers themselves, or a series of ratios of which they are the lowest terms. But what does *πεμπάδι συζυγείς* mean? Dupuis apparently (his work is inaccessible to me) took this in connection with the preceding expression *ὧν επίτροπος πυθμήν* to be another way of referring to the number 216, and, understanding the following expression, *ἑκατὸν τοσαυτάκις*, to mean that this was to be multiplied by 100, obtained 21,600 for the mystic number. Hultsch, on the other hand, takes *συζυγείς* to mean "add," and so to 3+4 adds 5, obtaining 12. Understanding *τρὶς αὔξηθείς* to mean simply "multiply by three," he so multiplies, and obtains 36. He then understands the words *ἑκατὸν τοσαυτάκις, τὴν δὲ ἰσομήκη μὲν τῇ,* to mean that the number in Plato's mind was $(36 \times 100)^2 = 3600^2 = 12{,}960{,}000$, though he admits that it is "Ein dunkler und mehrdeutiger Ausdruck." Hultsch claims that Plato thought of an ecliptical year, and notes that while modern astronomy shows that year to be 25,800 years, there is evidence in Tacitus (*Dial. de Oratione*, 16) that the ancients thought it to be 12,754 and 12,854, and Cicero (*Fragments of Hortensius*) that they thought it to be 12,954 years. Hultsch, therefore, supposes Plato thought it to consist of 12,960 years.

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[1] *Le Nombre géométrique de Platon*, 1881.

[2] *Zeitschrift für Mathematik und Physik*, vol. xxviii, Heft. 2, p. 41 ff.

[3] *The Dialogues of Plato*, III, 250.

[4] *The Republic of Plato*, III, 371 ff.

[5] *The Republic of Plato*, II, 206 ff, and Excursus at the end of the work.

Jowett, Monroe,[1] and Campbell, following a suggestion of Otto Weber, interpret differently. Weber[2] understood *πυθμήν* to suggest a series of ratios, and anticipated Hultsch in interpreting *συξυγείς* to mean "add". He thought that on the whole the last part of Plato's description of the number was best satisfied by the proportion 6400:4800::3600:2700. Adding 6400 and 3600 he obtained 10,000, which he thought represented Plato's square, being the square of 100 (i. e., was 100 times as large as 100). Adding 4800 and 2700 he obtains for the oblong 7,500 (i. e., 100 × by 75). The sum of these two is 17,500, which Weber thought to represent the number. Jowett, while adopting Weber's suggestion as a possible explanation, presents an alternative explanation, based on the last part of Plato's words (*ἑκατὸν μὲν ἀριθμῶν ἀπὸ διαμέτρων ῥητῶν πεμπάδος*, etc.). He takes this language, in the manner explained below, to denote 4900 and 2700 respectively. These he adds, together with 400 which he had obtained from an interpretation of *ἑκατὸν τοσαυτάκις*, making the whole number 8000.[3]

Adam interprets differently, and with much greater philological and mathematical accuracy. His first attempt, *The Nuptial Number of Plato*, Cambridge, 1891, was severely criticised by Monroe (*Classical Review*, vol. vi, 152 ff.), and Gow, (*Jour.*

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[1] *Journal of Philology*, viii, 276 ff.

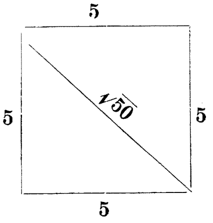
[2] *De Numero Platonis*, Cassel, 1862.

[3] *Dialogues of Plato*, III, p. cxxx ff.

of Phil., xii, 91 ff.). The weaknesses of his first interpretation have been corrected in his edition of *Plato's Republic*, 1902. He notes that *συξυγείς*, in the language of the Pythagoræans, meant "marry," and that, as applied to numbers, it meant "multiply". He accordingly interprets *ὧν ἐπίτροπος πυθμὴν πεμπάδι συξυγείς* to mean 3×4×5=60. He then shows that in Greek mathematical language *τρὶς αὐξηθείς* can only mean "multiplied by itself three times," i. e., "raised to the fourth power;" that to make it mean anything else reduces some mathematical passages in Greek writers to an absurdity. This gives him the number 12,960,000. He has reached the same goal as Hultsch, but by a more defensible path.

This result is confirmed by what Hultsch and Adam understand Plato's following words to mean. Plato says that this number produces "two harmonies, the first a square which is a hundred times as great" (*τὴν μὲν ἴσην ἰσάκις, ἑκατὸν τοσαυτάκις*); i. e., 12,960,000 represents the square of 3600. 3600 consists of two factors, 100 and 36, i. e., 3600—the root of the whole number—Plato says is 100 times as great as 36. This number 36 would also produce two harmonies,[1] 6×6 and 4×9. In like manner this larger number, when resolved into its factors, produces "two harmonies," one of which, 3600, is a square and is 100 times as great as 36. The other harmony consists of an oblong figure one side of which is obtained by squaring 5, taking its rational diameter (i. e., disregarding the fraction), squaring it, multiplying by 100, and subtracting 100 from the result, or says Plato, if the diameter is irrational (i. e., the fraction is not disregarded) 200 are to be subtracted. Hultsch, Jowett, Campbell and Adam agree that this is Plato's meaning, and represent it in diagram as follows:—

$$7^2\times 100=4900-100=4800,$$
$$\text{or } 50\times 100=5000-200=4800.$$



The second factor Plato says is the cube of three multiplied by 100, i. e., 2700.

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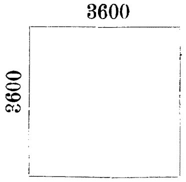
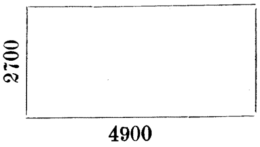
[1] So Hultsch, *op. cit.*, p. 45.

Jowett and Campbell would add these two numbers together, but Hultsch and Adam are, I believe, right in claiming that they are to be multiplied. Adam has treated the matter most exhaustively from every point of view, and, until some new material is discovered, seems to me to have said the most convincing, if not the final word on it. He has made out clearly, then, that Plato meant to say that this large number represented two geometrical figures, one a square of 3600, thus:



the other an oblong, thus:



Adam holds that the number 12,960,000 represented to Plato a world year 36,000 years long, expressed in days, 360 days being counted to the year.

Dr. Georg Albert of Vienna, however, who in 1896 had advocated the view that the number represents the precession of the equinoxes, while he admits[1] that a comparison of the Babylonian material gives to the number 12,960,000 advocated by Hultsch and Adam an added argument, still believes that Plato had in mind a number of which 2592 was one factor and 3600 the other, and that 2592 represented to his mind the precession of the equinoxes.

He reaches this result for the factor 2592 by adhering to the idea that πυθμήν suggests a ratio, with which 3 and 4 have something to do. He gives a long list of these ratios, and then selects 81 : 36 :: 72 : 32 as the ratio contemplated by Plato, apparently because the product of the extremes and means of this proportion is in each case 2592, the ecliptical number without its ciphers—a method which is extremely arbitrary. There is much justice in the remark of Adam (*Republic*, II, p. 275 n.),

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[1] *Die Platonische Zahl als Präzessionszahl*, Leipzig und Wien, 1907.

"Nothing can be done with them [ratios] without having recourse to arbitrary calculations for which there is no warrant in Plato's language." The reasoning of Albert gives one the feeling that he reached his result and then made his argument afterwards. In comparison with Adam's logical method it does not commend itself.

My own view is that if we approach the matter without presuppositions in favor of any theory and interpret the passage from the point of view of Greek alone, we must be convinced of the soundness of Adam's interpretation, and hold the number to be 12,960,000.

If now we turn to the Babylonian side, the general course of discovery in this direction has been as follows:

Rawlinson,[1] and Oppert,[2] in the early days of Assyrian decipherment, discovered the sexagesimal system and the notation of the *saros.* Rawlinson, in 1855, suggested that this was carried beyond the *saros* to 216,000. As early as 1866 Brandis had in his *Münz-, Mass- und Gewichtswesen in Vorderasien,* p. 7, inferred that the Babylonians carried the sexagesimal progression on to 12,960,000.

In 1875 the mathematical tablet, brought from Senkereh by Loftus in 1850, was published in IV R. In the same year Oppert presented a translation of it in his *L'Etalon des mesures Assyriennes, fixé par les textes cunéiformes,* pp. 24–27. Here the matter lay until 1893, when the subject was taken up by Aurès. Dupuis had twelve years before published his interpretation of the Platonic number, and had made the number 21,600. The highest number given in the tablet of Senkereh was 21,600. It does not appear that Aurès was aware of the paper of Hultsch, referred to above, although that had been called out by the work of Dupuis. Had he known it, however, probably two reasons would have induced him to follow the work of Dupuis, patriotism (Aurès and Dupuis both being French), and the fact that the tablet of Senkereh seemed to confirm Dupuis' calculation. Aurès believed that the fact that the circle was divided into 360°, and each degree into 60 minutes, making 21,600 minutes in a circle, was proof that this number had played an important part in ancient thought. Aurès, so far as I know, deserves, however, the credit of having first suggested the Babylonian origin of this mystic number of Plato.

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[1] JRAS. xv, 218, 219.

[2] *Éléments de la grammaire assyrienne,* 2d ed., p. 41.

Again in 1902 Adam, who knew nothing apparently of the work of Aurès, pointed out in his edition of the *Republic*[1] that the number 12,960,000 seemed to be connected with the Babylonian sexagesimal system. He did this on the basis of the work of Brandis referred to above, apparently knowing nothing of the intervening progress of Assyriology.

Before Hilprecht published his work referred to above, then, the Babylonian origin of the Platonic number had been twice suggested, once by Aurès and once by Adam, each working independently of the other.

We are now in a position to estimate justly the value of Hilprecht's contribution to the subject. That the mathematical tablets published by him have been in general correctly interpreted may be readily conceded. That these practice tablets contain fractions and factors of 12,960,000 in such a way as to show that that number played an important rôle in Babylonian thought, he has also clearly made out. In his table on p. 21 there are, however, two errors. Opposite 25 we should have 518,400 instead of 518,000; and opposite 50 we should have 259,200 instead of 259,000. These corrected numbers are called for by the series and are actually present in the text.[2] The mistakes may be mere typographical errors. The material presented here by Hilprecht tends greatly to strengthen the view that the mystic number of Plato is of Babylonian origin. It strengthens it, because it gives for the first time actual evidence from the Babylonian side that the number 12,960,000 really played an important part in Babylonian thought. It makes it more probable that Pythagoras, whom Plato followed, as Adam and others have so clearly shown, was profoundly influenced by Babylonia. This added material is most welcome.

It must be confessed, however, that Hilprecht's work in this respect deserves far less credit than has been accorded it. Perhaps like his reviewers he was ignorant of the work of Aurès. He did, however, know the work of Adam, and still gave him no credit for having suggested the Babylonian origin of the number.

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[1] Vol. ii, pp. 302, 303.

[2] See Hilprecht, *op. cit.*, No. 20, col. I, 16, 25; and col. IV, 16 and 24.

Albert, at the end of his last discussion of the Platonic number (1907), holds that there are three possibilities as to its origin:

1. Plato had borrowed the magnitude and the idea of his number, probably also its construction, from the Babylonians. This hypothesis, adds Albert, appears to me sufficiently improbable.

2. Plato had learned the fact of the procession of the equinoxes, the determination of their size, and the hypothesis of their period of revolution, from the star-gazers of Attica and explained them in a philosophical manner.

3. Plato had received from the astronomers the idea that 72 years marked a definite step of the advance of the equinoxes, and independently built up from it the full period and made this of service to his ethical-biological reflections. This last idea may have been suggested through primeval oriental myths.

These conclusions of Albert seem to me inadequate and improbable. Here is a number, 12,960,000, which independent investigations in Greek and in Babylonian civilization have, as I think, demonstrated to have played an important part in the thought of these nations respectively. Is it probable that this complicated number was arrived at independently by the two peoples? The traditions of the oriental travels of Pythagoras, even if we discount them considerably as Zeller[1] does, may contain an element of truth. But supposing that he never went to the East himself, Cyrus had conquered Sardis and attached the kingdom of Croesus to the Persian empire in the year 546, and had overthrown Babylon in 538. If Pythagoras lived in Samos in the last half of the sixth century, the channels through which Babylonian thought might filter through to him were all open. Moreover Hesiod (*Works and Days,* 562) seems to contain a reference to a sexagesimal system of numbers. Herodotus (2^{109}) says definitely that the division of the day into twelve parts was derived by the Greeks from the Babylonians. In how many ways the sexagesimal system entered into the Babylonian conception of the world, Winckler has shown in his *Himmels-*

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[1] *Pre-Socratic Philosophy,* i, 334.

und Weltenbild der Babylonier, Leipzig, 1901, p. 15 ff. If the Greeks borrowed a part of the Babylonian sexagesimal system, it seems fair to infer that, when other parts of it appear in Greek life, they were also borrowed. We learn, too, from Berossos that the Babylonians had the notion of a 36,000 year period. In spite of Albert's argument, therefore, it seems to me that the Babylonian origin of Plato's mystic number is raised to a high degree of probability, if not to practical certainty. This may be said, too, without thereby endorsing the extravagances of the German pan-Babylonians.